Diversity of Broadleaf Undergrowth Plants in the Pananjung Pangandaran Nature Reserve Area, West Java

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Abstract. The Pananjung Pangandaran Nature Reserve in West Java, designed as a dual-purpose tourist destination and nature sanctuary, faces a notable threat to the diversity of its wide leafy plant undergrowth within the Pangandaran forest due to human activities. This study employs a descriptive qualitative approach and a belt transect research design, utilizing purposive sampling for sample selection, to evaluate the undergrowth diversity in the reserve. Observations reveal 14 undergrowth species, spanning herbaceous plants, shrubs, and saplings, totalling 1677 individuals across 11 families and 13 genera. The calculated diversity index ($H'$) is 1.846, indicating a moderate level of undergrowth diversity. The importance value index (IVI) determines the significance of undergrowth plants, with Elaeocarpus sp. exhibiting the highest value at 97.85% and Kleinovia hospita L. the lowest at 1.060%. In summary, the development of Pananjung Pangandaran Nature Reserve as a tourist park and sanctuary holds the potential to diminish the diversity of wide leafy plant undergrowth. This study identifies 14 undergrowth species with moderate diversity, emphasizing the need for meticulous planning and conservation measures to counteract the adverse effects of human activities on the area's natural diversity.

1 Introduction

Forests are a very valuable resource [1]. Forests are an important part of the climate because forests have an ecological function that is useful as a source of germplasm, limiting carbon dioxide ($CO_2$) from the air, maintaining solid water quality, maintaining normal water flow, and protecting soil from disintegration [2]. There are approximately 100 forests in Indonesia, including the Pananjung Pangandaran Nature Reserve [3]. Pananjung Pangandaran Nature Reserve is a conservation area with the characteristics of a tourist destination that interests tourists (Directorate General of PHKA). The Pananjung Pangandaran Nature Reserve area is often shaped like a hand grip and is isolated into two parts: the western part is a tourism forest, and the eastern part is a nature reserve area, which is mostly off-limits to tourists [4]. The 497-hectare Pananjung Pangandaran Nature Reserve is a rainforest ecosystem that can

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be found on the south coast of West Java. The Pananjung Pangandaran Nature Reserve is special because it is a peninsula surrounded by beaches to the west and east, slightly separated from the central area of Pangandaran Regency [5]. Broadleaf undergrowth plant is a type of plant that covers the surface of the forest, usually in the form of low-growing shrubs and shrubs [6]. Plant communities called undergrowth form the underside of the forest floor close to the ground surface. Most are grasses, herbs, shrubs or low shrubs [7]. The broadleaf undergrowth plant is a local plant that forms a layer at the bottom of the forest and stands close to the ground surface. The undergrowth plant is generally a cover plant but can be considered a weed with the assumption that its development has disturbed the main plant [8]. This research focuses on the Undergrowth of broadleaf plants, a vital but often overlooked aspect of plant ecosystems. Our choice is driven by the Undergrowth's ecological significance, playing a crucial role in plant communities. The Pangandaran Nature Reserve in Indonesia is specifically chosen for its representation of this undergrowth diversity. This study aims to unravel the ecological importance of Undergrowth plants and leverage insights from Pangandaran to enhance our broader understanding of this critical botanical component. Judging from the role of the undergrowth under the forest stand and the large number of people who do not know about the various types of broadleaf undergrowth in the Cirengganis block, Pananjung Pangandaran Nature Reserve Area. It is very important that the surrounding community play a proactive role in protecting and preserving the diversity of broad leaf undergrowth in the Cirengganis block in the Pananjung Pangandaran Nature Reserve area. Hence, it is crucial to undertake a comprehensive investigation to uncover the rich diversity of broadleaf Undergrowth plants within the Pananjung Pangandaran Nature Reserve Area located in West Java.

2 Material and methods

2.1 Time and Place of Research

This research was located in the Cirengganis block in the Pananjung Pangandaran Nature Reserve area, West Java, and was carried out in June 2022. This study used a qualitative descriptive method with a belt transect research design with six transect lines length of 110 meters. The setup consists of squares, each comprising six plots measuring 10 x 10 meters. Within every square, one plot occupies 10 x 10 meters, and the distance between squares is 10 meters. Additionally, within each 10 x 10-meter plot, there are five sub-plots, each measuring 2 x 2 meters. The purposive sampling method was used to collect specific broadleaf plants as samples. Measuring tape, transect lines, cameras, scissors, and observation sheets were used in this study. Lux meters, soil testers, thermometers, and hygrometers are tools used to measure environmental factors.

2.2 Data collection

Data collection involved purposive sampling, focusing on herbaceous broadleaf undergrowth, shrubs, and tree saplings with a maximum diameter of 2 cm beneath tree stands. The plant data was meticulously gathered in this manner. Simultaneously, microclimate data, encompassing abiotic factors like air temperature, humidity, light intensity, soil pH, and soil temperature and humidity, was collected using measurement tools with three replications.
2.3 Data analysis

Following data collection, the Shannon-Wiener Diversity Index (H') and the Importance Value Index (IVI) were computed, as outlined by Lamont et al. [9]. The classification, rooted in the Shannon-Wiener criterion, categorizes species diversity based on H' values: H' < 1 indicates low diversity, H' = 1-3 suggests moderate diversity, and H' > 3 signifies high species diversity. Additionally, metrics such as Relative Density (RD), Relative Frequency (RF), and Relative Dominance (RD) were considered in the analysis.

\[ H' = - \sum_{i=1}^{s} p_i \ln p_i \]  

\[ H = \text{Shannon-Wiener diversity index} \]
\[ p_i = \text{fraction of the entire population made up of species } i \]
\[ s = \text{numbers of species encountered}. \]

3 Result and discussion

3.1 Result

The diversity index of broadleaf undergrowths in the Pananjung Pangandaran Nature Reserve was determined at (H') = 1.846 based on calculations, as can be seen in Table 1. This value indicates that the diversity of undergrowth in the region can be categorized as moderate based on the results. The species with the highest IVI was *Elaeocarpus* sp. 97.85%, followed by *Dysoxylum densiflorum* 50.54%, as seen in Table 2. While the species with the lowest IVI was *Kleinhovia hospita* L. of 1.060%. Thus, *Elaeocarpus* sp. is a species that is able to adapt to the environment and has the highest ecological significance for the lowland forest environment. The Importance Value Index is obtained from the sum of the Relative Density (RD), Relative Frequency (RF), and Relative Dominance (RD). Important Value Index (IVI), describes the importance of the function of plant species in their ecosystem. A vegetation type will have a significant impact on ecosystem stability if the IVI is high [10].

**Table 1.** Data on diversity index of broadleaf undergrowth plants in the Pananjung Pangandaran Nature Reserve Area, West Java

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Abundance</th>
<th>Pi</th>
<th>Ln Pi</th>
<th>H’</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Hoya</em> sp.</td>
<td>2</td>
<td>0.001</td>
<td>6.732</td>
<td>0.008</td>
</tr>
<tr>
<td>2.</td>
<td><em>Lasianthus</em> sp.</td>
<td>24</td>
<td>0.014</td>
<td>4.247</td>
<td>0.061</td>
</tr>
<tr>
<td>3.</td>
<td><em>Elaeocarpus</em> sp.</td>
<td>536</td>
<td>0.320</td>
<td>1.141</td>
<td>0.365</td>
</tr>
<tr>
<td>4.</td>
<td><em>Derris trifoliata</em></td>
<td>5</td>
<td>0.003</td>
<td>5.815</td>
<td>0.017</td>
</tr>
<tr>
<td>5.</td>
<td><em>Andrographis</em> sp.</td>
<td>54</td>
<td>0.032</td>
<td>3.436</td>
<td>0.111</td>
</tr>
<tr>
<td>6.</td>
<td><em>Hernandia peltata</em></td>
<td>215</td>
<td>0.128</td>
<td>2.054</td>
<td>0.263</td>
</tr>
<tr>
<td>7.</td>
<td><em>Dysoxylum gaudichaudianum</em></td>
<td>3</td>
<td>0.002</td>
<td>6.326</td>
<td>0.011</td>
</tr>
<tr>
<td>8.</td>
<td><em>Psychotria</em> sp.</td>
<td>62</td>
<td>0.037</td>
<td>3.298</td>
<td>0.122</td>
</tr>
<tr>
<td>9.</td>
<td><em>Kleinhovia hospita</em> L.</td>
<td>1</td>
<td>0.001</td>
<td>7.425</td>
<td>0.004</td>
</tr>
</tbody>
</table>
Table 2. Data on the Importance Value Index (IVI) of broadleaf undergrowth plants in the Pananjung Pangandaran Nature Reserve, West Java

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>RD (%)</th>
<th>RF (%)</th>
<th>RDo (%)</th>
<th>IVI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hoya sp.</td>
<td>0.119</td>
<td>0.917</td>
<td>0.207</td>
<td>1.243</td>
</tr>
<tr>
<td>2.</td>
<td>Lasianthus sp.</td>
<td>1.431</td>
<td>4.587</td>
<td>1.820</td>
<td>7.838</td>
</tr>
<tr>
<td>3.</td>
<td>Elaeocarpus sp.</td>
<td>31.96</td>
<td>25.69</td>
<td>40.20</td>
<td>97.85</td>
</tr>
<tr>
<td>4.</td>
<td>Derris trifoliata</td>
<td>0.298</td>
<td>0.917</td>
<td>0.165</td>
<td>1.381</td>
</tr>
<tr>
<td>5.</td>
<td>Andrographis sp.</td>
<td>3.220</td>
<td>3.670</td>
<td>5.583</td>
<td>12.47</td>
</tr>
<tr>
<td>6.</td>
<td>Hernandia peltata</td>
<td>12.82</td>
<td>17.43</td>
<td>12.03</td>
<td>42.29</td>
</tr>
<tr>
<td>7.</td>
<td>Dysoxylum gaudichaudianum</td>
<td>0.179</td>
<td>0.917</td>
<td>0.620</td>
<td>1.717</td>
</tr>
<tr>
<td>8.</td>
<td>Psychotria sp.</td>
<td>3.697</td>
<td>7.339</td>
<td>4.467</td>
<td>15.50</td>
</tr>
<tr>
<td>9.</td>
<td>Kleinhovia hospita L.</td>
<td>0.060</td>
<td>0.917</td>
<td>0.083</td>
<td>1.060</td>
</tr>
<tr>
<td>11.</td>
<td>Mischocarpus sp.</td>
<td>17.89</td>
<td>8.257</td>
<td>10.26</td>
<td>36.40</td>
</tr>
<tr>
<td>12.</td>
<td>Dysoxylum densiflorum</td>
<td>19.62</td>
<td>13.76</td>
<td>17.16</td>
<td>50.54</td>
</tr>
<tr>
<td>13.</td>
<td>Scutellaria sp.</td>
<td>0.119</td>
<td>0.917</td>
<td>0.207</td>
<td>1.243</td>
</tr>
<tr>
<td>14.</td>
<td>Diplopterys cabrerana</td>
<td>1.371</td>
<td>5.505</td>
<td>1.985</td>
<td>8.861</td>
</tr>
<tr>
<td>∑</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>300</td>
</tr>
</tbody>
</table>

3.2 Discussion

Based on observations, it was found that 14 species of broadleaf undergrowth plants, totalling 1677 individuals, included herbaceous plants, shrubs and tree saplings belonging to 9 ordo, 11 family and 13 genera. It can be seen that the presence or composition of broadleaf undergrowth in the Pananjung Pangandaran Nature Reserve area has a fairly even distribution. Elaeocarpus sp. is the species with the largest number of individuals, 536 individuals in all quadrants. The IVI indicate the important role of undergrowth plants in a
community. Undergrowth primarily serves to shield against rainwater impact and surface runoff, concurrently enhancing soil organic matter through contributions like green manure or mulch [10].

This is related to the state of the climatic factors that affect the magnitude of the IVI in these species. *Elaeocarpus* sp. can survive in a dry condition with limited soil nutrition [11]. This plant can grow in various light conditions, ranging from shade to bright light. This is consistent with the field conditions where *Elaeocarpus* sp. in all quadrants with abiotic environmental conditions, the light intensity ranged from 1,200–11,100 lux, air temperature 26-28°C, air humidity 92-92.5%, soil temperature 27-29°C, soil moisture 80%, and soil pH 5-7. Therefore, with abiotic factors that have been measured, this species dominates in all quadrants, because the species *Elaeocarpus* sp. can be found in swamps and coastal areas [12].

Abiotic factors such as air temperature and humidity, light intensity, soil pH, and soil temperature and humidity support the diversity of broadleaf undergrowth plants in the study area. Environmental factors found in a place have a significant impact on the diversity of undergrowth plants [13]. The interaction between vegetation and soil physico-chemical characteristics, temperature and humidity has an indirect impact on its distribution. This creates an environmental state that determines whether a species exists and spreads with varying degrees of adaptation.

As a comparison, looking at the research findings explaining that in the Gadungan Manggis Nature Reserve, 13 species of undergrowth were found with moderate diversity. Temperature, humidity, light intensity, and soil acidity are some of the variables that affect this diversity and limit the types of undergrowth under their cover [10].

Meanwhile, another research finding revealed that the diversity of plant species under the peat swamp forest in Banjar Regency was found to be 24 species and classified as moderate. This is influenced by environmental factors that shift in response to local demands, which are influenced by human activities, as well as genetic interactions and acidic soil types that affect differences in plant species and diversity of undergrowth in the area [2].

The state of diversity of Undergrowth species is influenced by a number of factors, as evidenced by the comparison of the different study areas. Factors that influence it are temperature, humidity, light intensity, soil acidity, genetic factors, and the influence of human activities so these factors have an impact on species diversity and the number of individual undergrowth plants.

### 4 Conclusion

In conclusion, the Pananjung Pangandaran Nature Reserve in West Java plays a vital ecological role, contributing to climate change mitigation, genetic diversity conservation, water regulation, and soil protection. Our study specifically focused on the undergrowth in the Cirengganis block, identifying 14 species, including herbs, shrubs, and saplings. *Elaeocarpus* sp. emerged as the dominant species, emphasizing its ecological significance. This study highlights the complex interplay of environmental conditions and human activities shaping undergrowth diversity. Protecting these species, particularly *Elaeocarpus* sp., is crucial for ecosystem stability. Conservation efforts in the Pananjung Pangandaran Nature Reserve should consider both natural and human influences.

### References

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